

FIG. 1
(Prior Art)

00635115-080900

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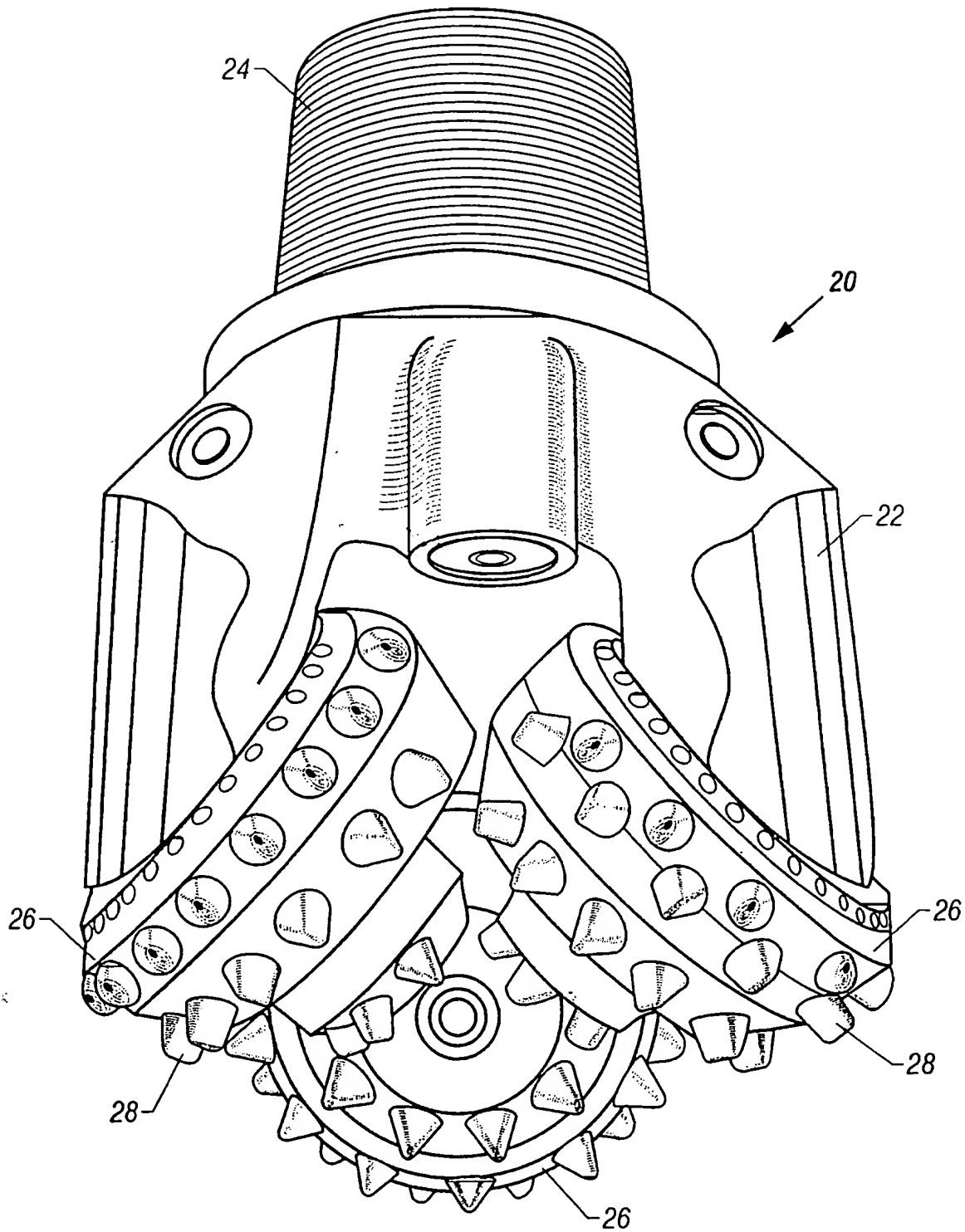
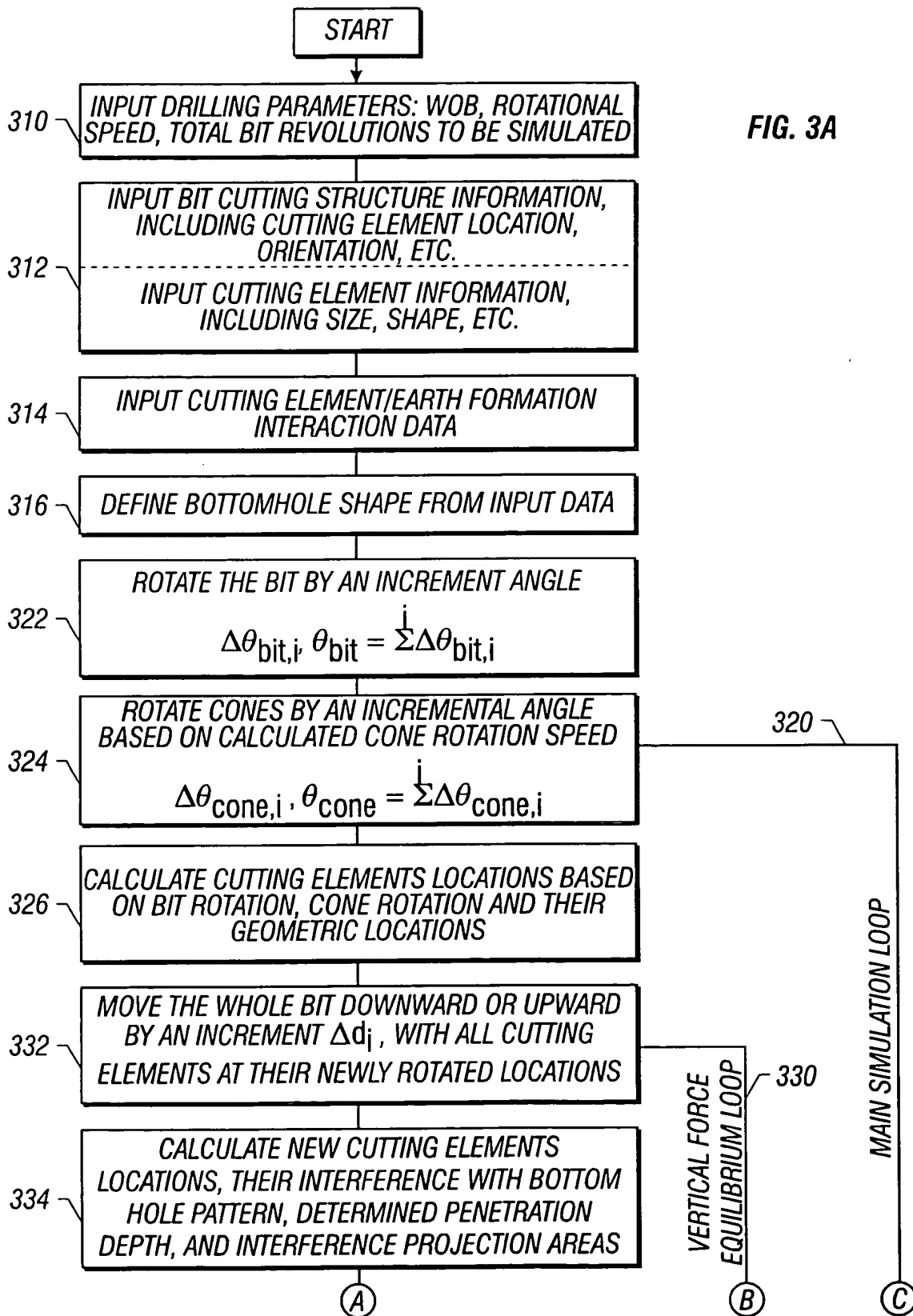


FIG.2
(Prior Art)

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FIG. 3A



006080" 9TTS960

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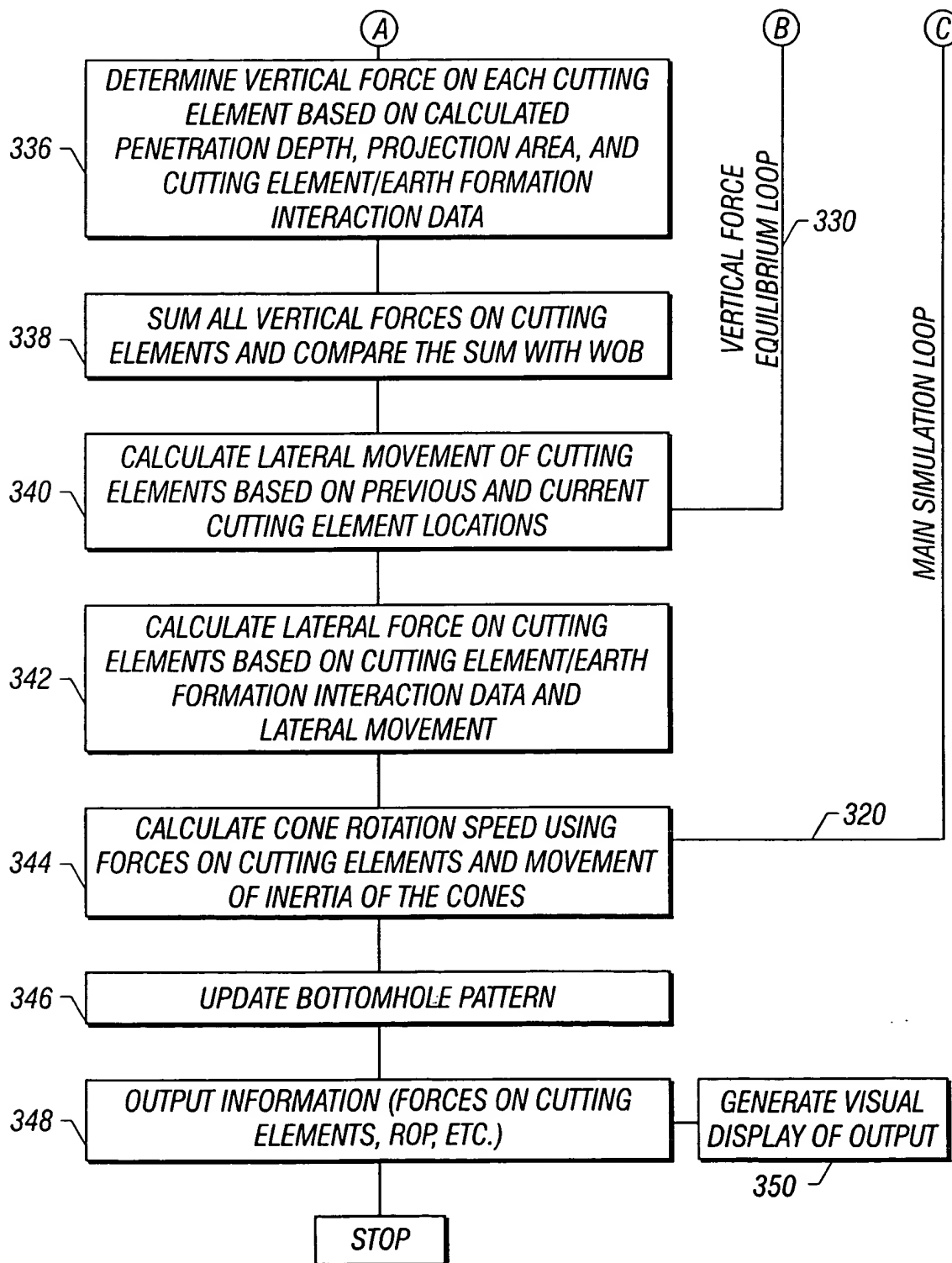


FIG. 3B

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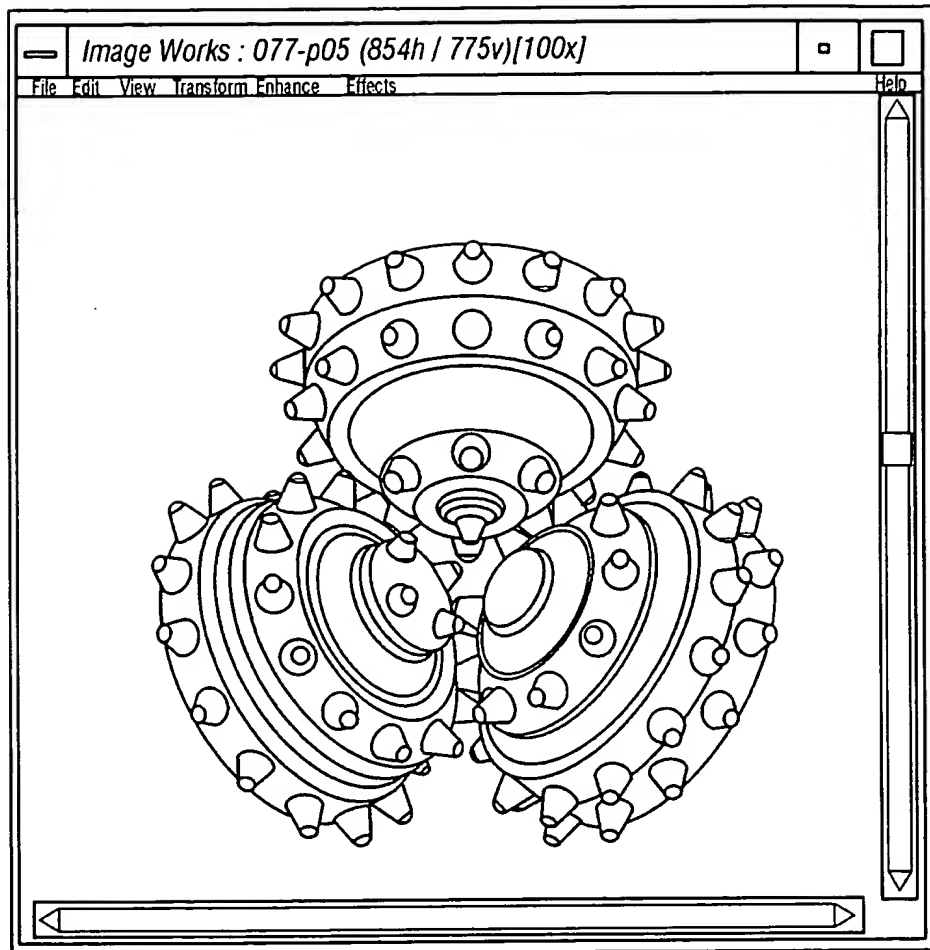


FIG. 4

006080" 9T5E960

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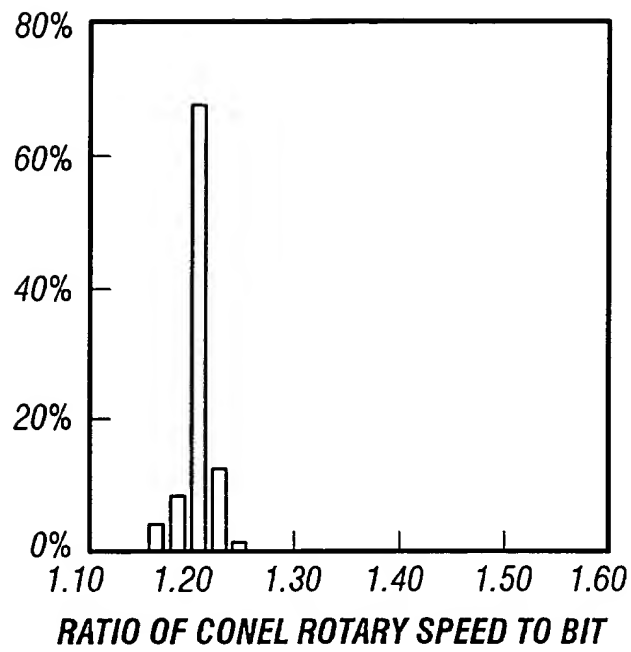


FIG. 6A

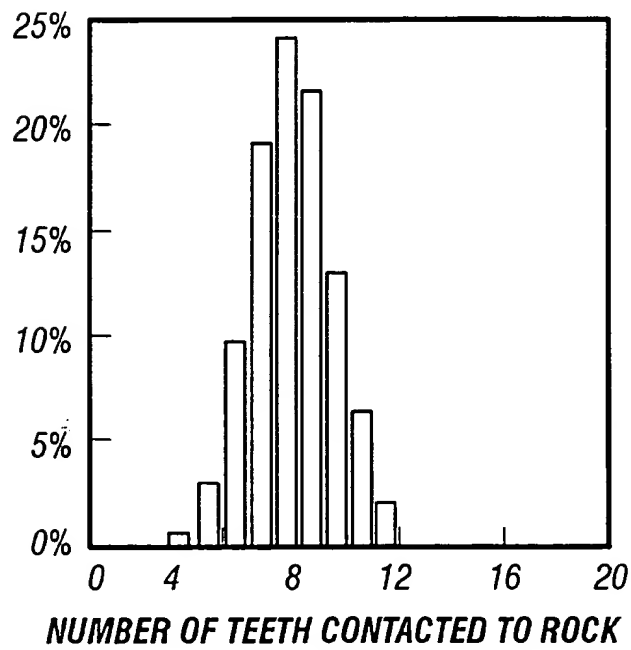


FIG. 6B

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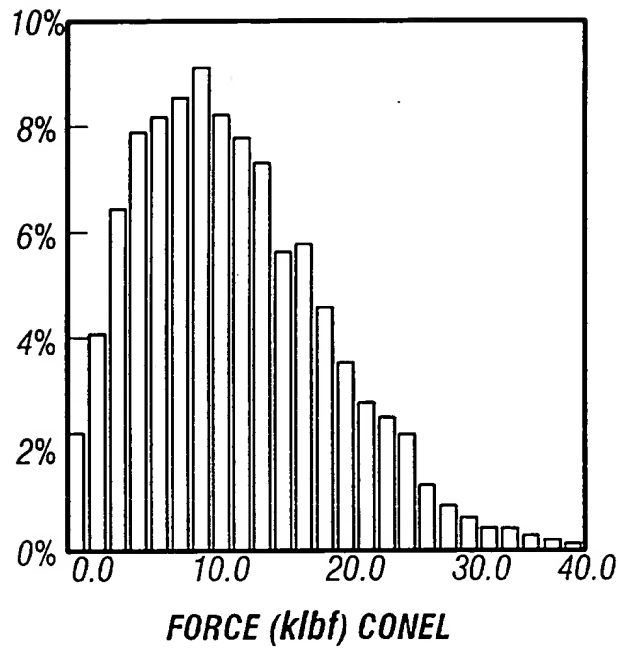
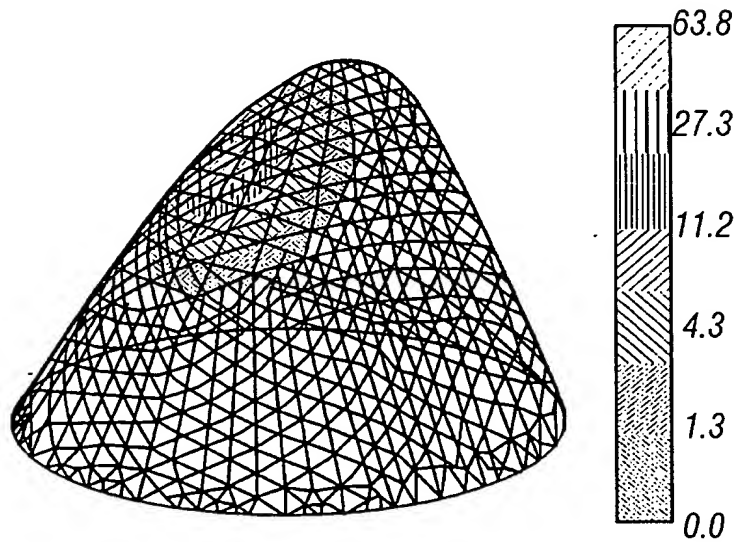


FIG. 6C

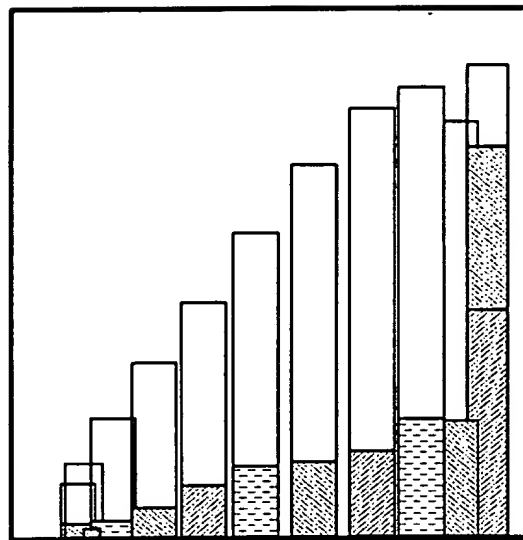


INSERT CUMULATIVE CUTTING

FIG. 6D

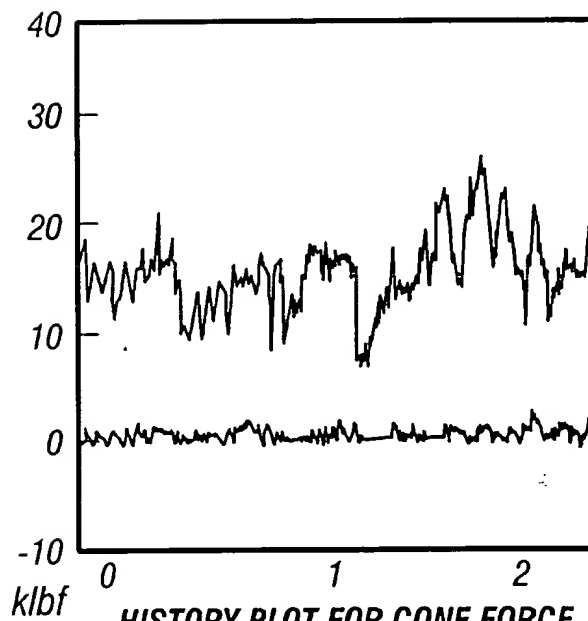
09635116-080900

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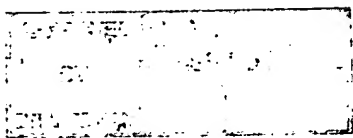
BOH COVERAGE

FIG. 6E



HISTORY PLOT FOR CONE FORCE

FIG. 6F



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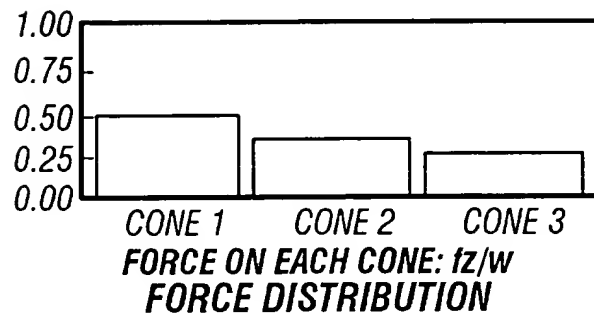
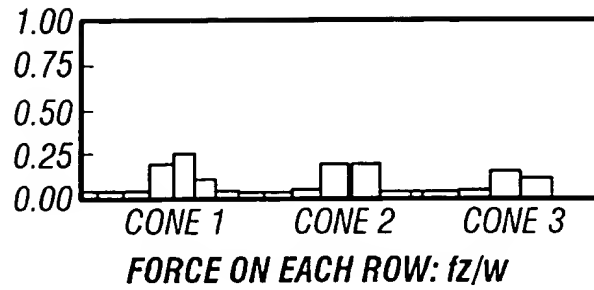


FIG. 6G

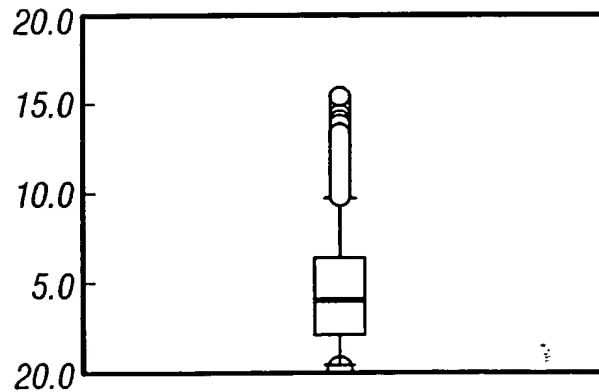


FIG. 6H

006080" 9TTS960

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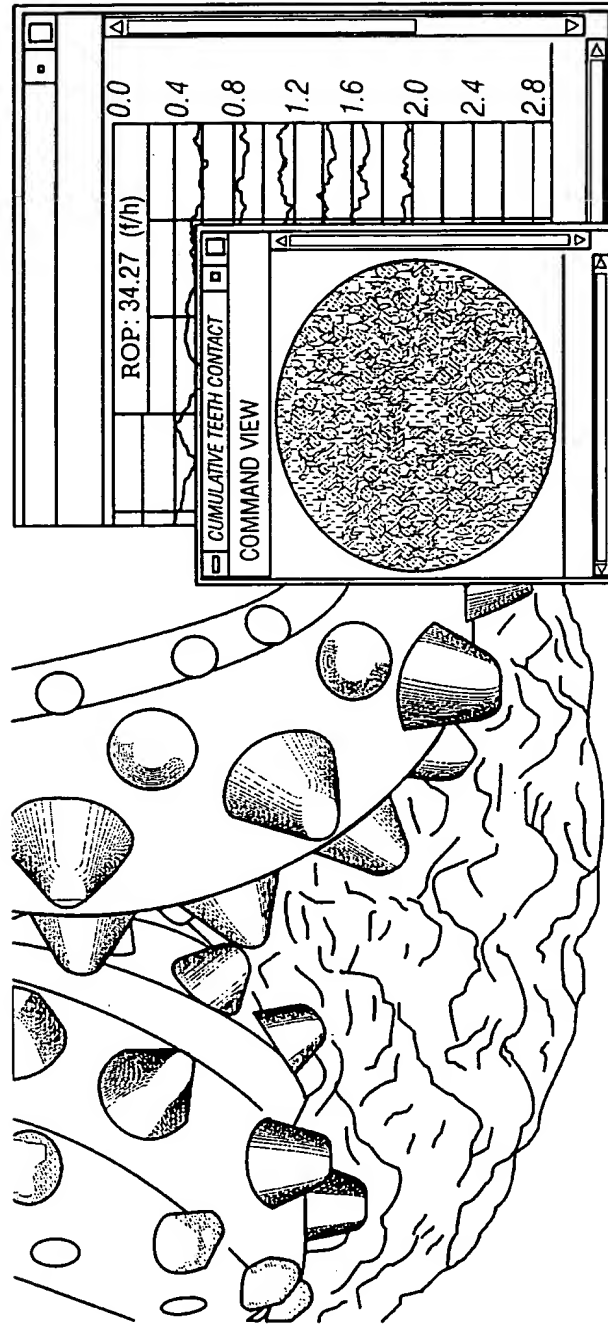


FIG. 7

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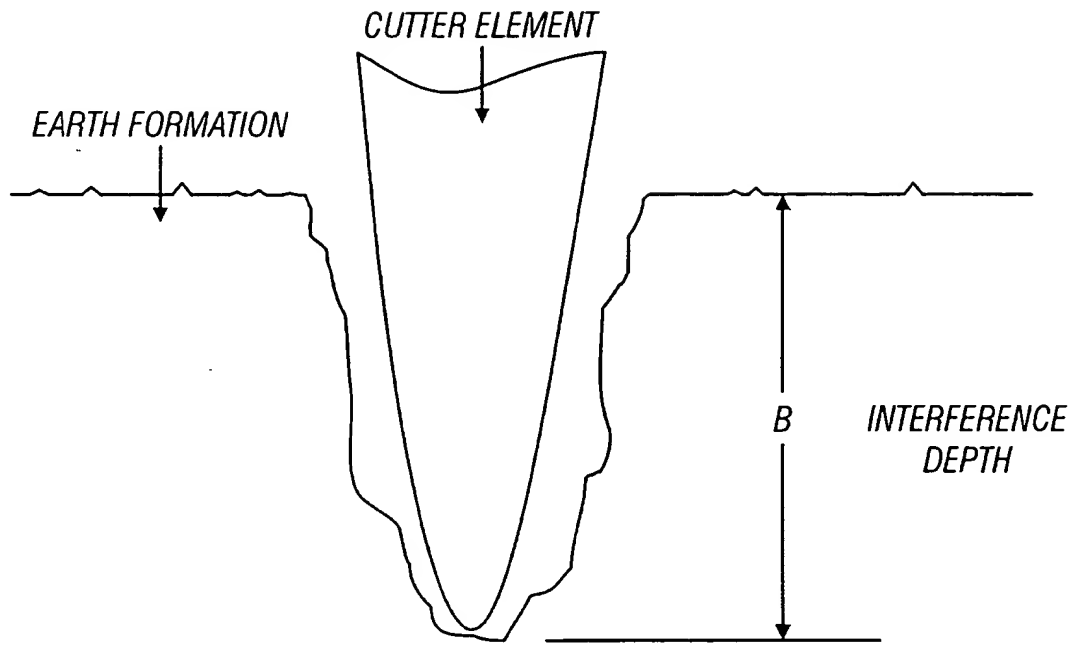


FIG. 8A

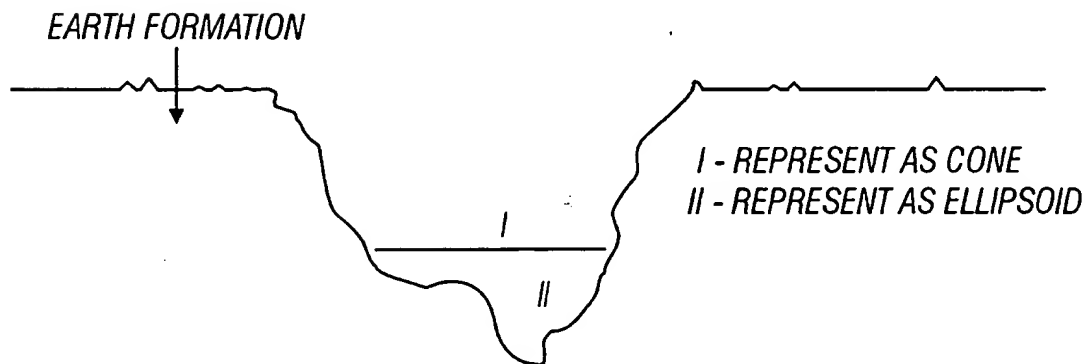


FIG. 8B

006080-9T5E960

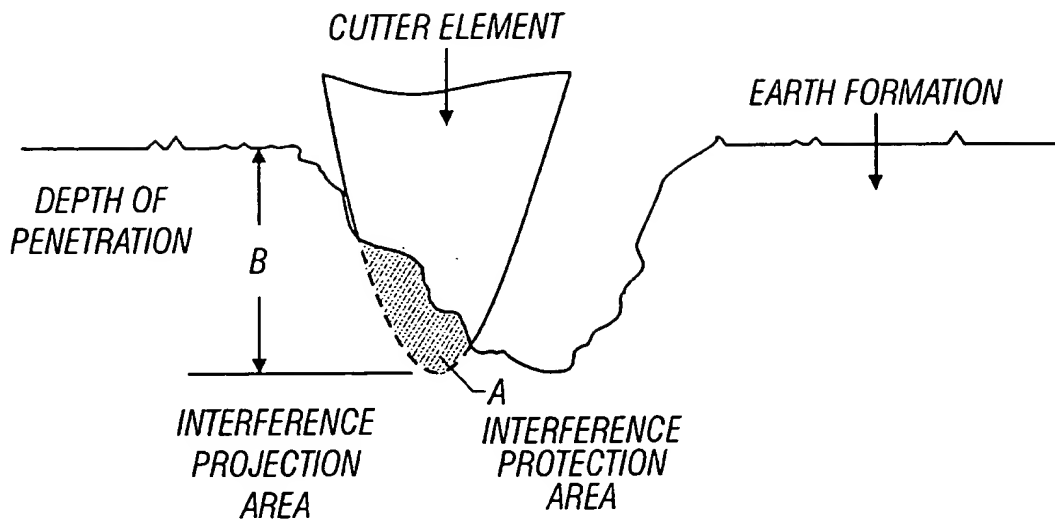


FIG. 8C

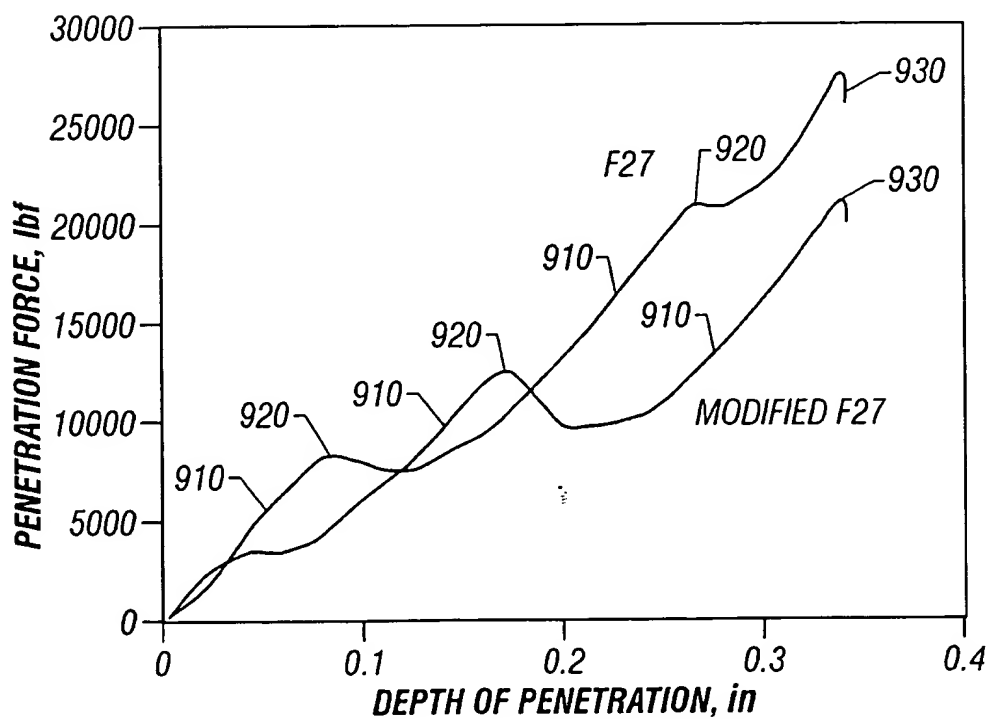
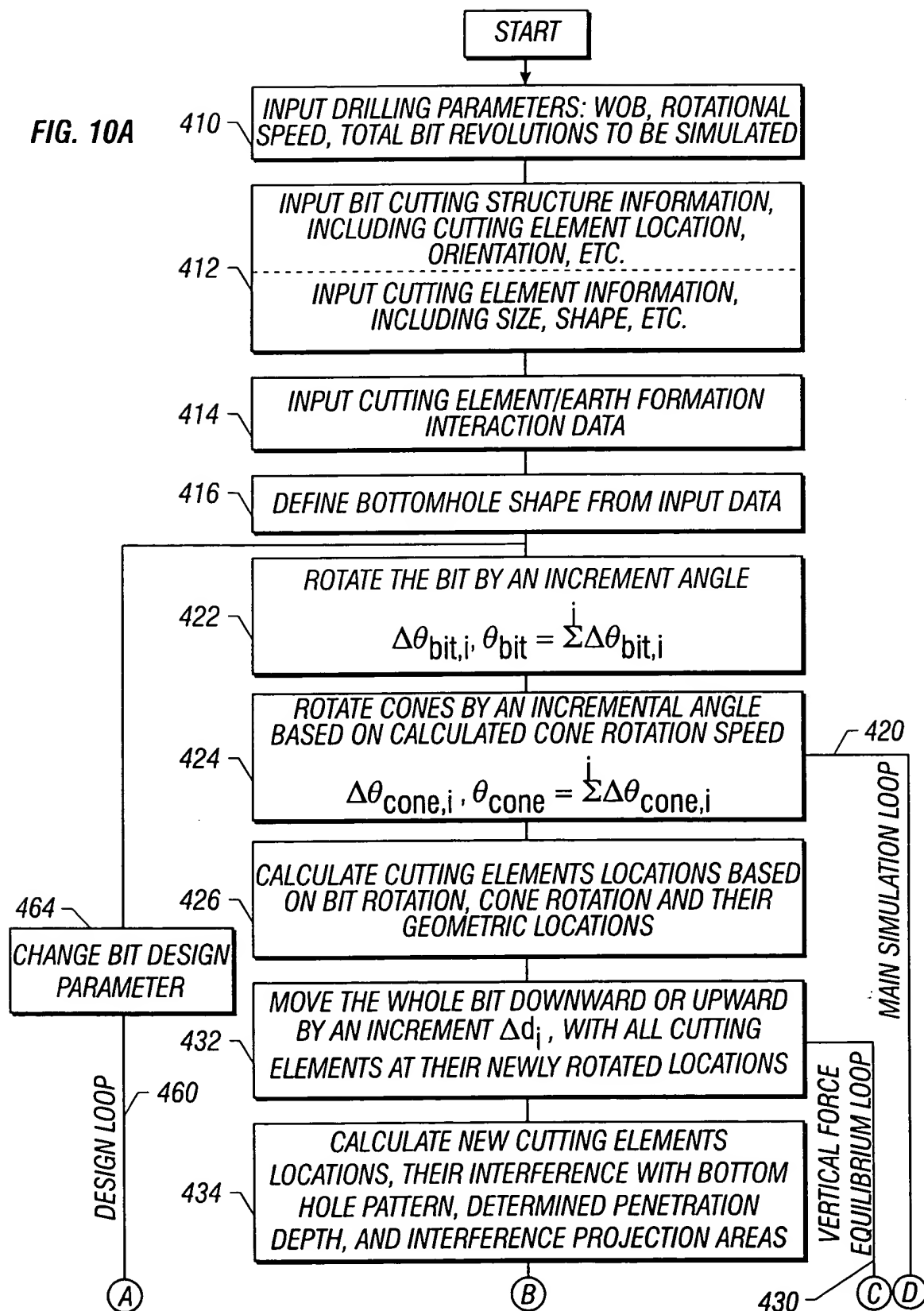


FIG. 9



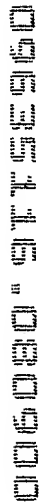


FIG. 10B

FIG. 11A

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graph TD
    START([START]) --> 510[510 INPUT DRILLING PARAMETERS: WOB, ROTATIONAL SPEED, TOTAL BIT REVOLUTIONS TO BE SIMULATED]
    510 --> 512[512 INPUT BIT CUTTING STRUCTURE INFORMATION, INCLUDING CUTTING ELEMENT LOCATION, ORIENTATION, ETC.]
    512 --> 514[514 INPUT CUTTING ELEMENT INFORMATION, INCLUDING SIZE, SHAPE, ETC.]
    514 --> 516[516 DEFINE BOTTOMHOLE SHAPE FROM INPUT DATA]
    516 --> 522[522 ROTATE THE BIT BY AN INCREMENT ANGLE  
Δθbit,i, θbit = Σi Δθbit,i]
    522 --> 524[524 ROTATE CONES BY AN INCREMENTAL ANGLE  
BASED ON CALCULATED CONE ROTATION SPEED  
Δθcone,i, θcone = Σi Δθcone,i]
    524 --> 526[526 CALCULATE CUTTING ELEMENTS LOCATIONS BASED  
ON BIT ROTATION, CONE ROTATION AND THEIR  
GEOMETRIC LOCATIONS]
    526 --> 532[532 MOVE THE WHOLE BIT DOWNWARD OR UPWARD  
BY AN INCREMENT Δdi, WITH ALL CUTTING  
ELEMENTS AT THEIR NEWLY ROTATED LOCATIONS]
    532 --> 534[534 CALCULATE NEW CUTTING ELEMENTS  
LOCATIONS, THEIR INTERFERENCE WITH BOTTOM  
HOLE PATTERN, DETERMINED PENETRATION  
DEPTH, AND INTERFERENCE PROJECTION AREAS]
    534 --> 530[530 VERTICAL FORCE EQUILIBRIUM LOOP]
    530 --> 560[560 DRILLING OPTIMIZATION LOOP]
    560 --> 564[564 CHANGE DRILLING PARAMETER]
    564 --> 522
    530 --> END([END])
```

510 INPUT DRILLING PARAMETERS: WOB, ROTATIONAL SPEED, TOTAL BIT REVOLUTIONS TO BE SIMULATED

512 INPUT BIT CUTTING STRUCTURE INFORMATION, INCLUDING CUTTING ELEMENT LOCATION, ORIENTATION, ETC.

514 INPUT CUTTING ELEMENT INFORMATION, INCLUDING SIZE, SHAPE, ETC.

516 DEFINE BOTTOMHOLE SHAPE FROM INPUT DATA

522 ROTATE THE BIT BY AN INCREMENT ANGLE
 $\Delta\theta_{\text{bit},i}, \theta_{\text{bit}} = \sum_i \Delta\theta_{\text{bit},i}$

524 ROTATE CONES BY AN INCREMENTAL ANGLE BASED ON CALCULATED CONE ROTATION SPEED
 $\Delta\theta_{\text{cone},i}, \theta_{\text{cone}} = \sum_i \Delta\theta_{\text{cone},i}$

526 CALCULATE CUTTING ELEMENTS LOCATIONS BASED ON BIT ROTATION, CONE ROTATION AND THEIR GEOMETRIC LOCATIONS

532 MOVE THE WHOLE BIT DOWNWARD OR UPWARD BY AN INCREMENT Δd_i , WITH ALL CUTTING ELEMENTS AT THEIR NEWLY ROTATED LOCATIONS

534 CALCULATE NEW CUTTING ELEMENTS LOCATIONS, THEIR INTERFERENCE WITH BOTTOM HOLE PATTERN, DETERMINED PENETRATION DEPTH, AND INTERFERENCE PROJECTION AREAS

560 DRILLING OPTIMIZATION LOOP

564 CHANGE DRILLING PARAMETER

520 MAIN SIMULATION LOOP

530 VERTICAL FORCE EQUILIBRIUM LOOP

END

A

(B)

530

C D

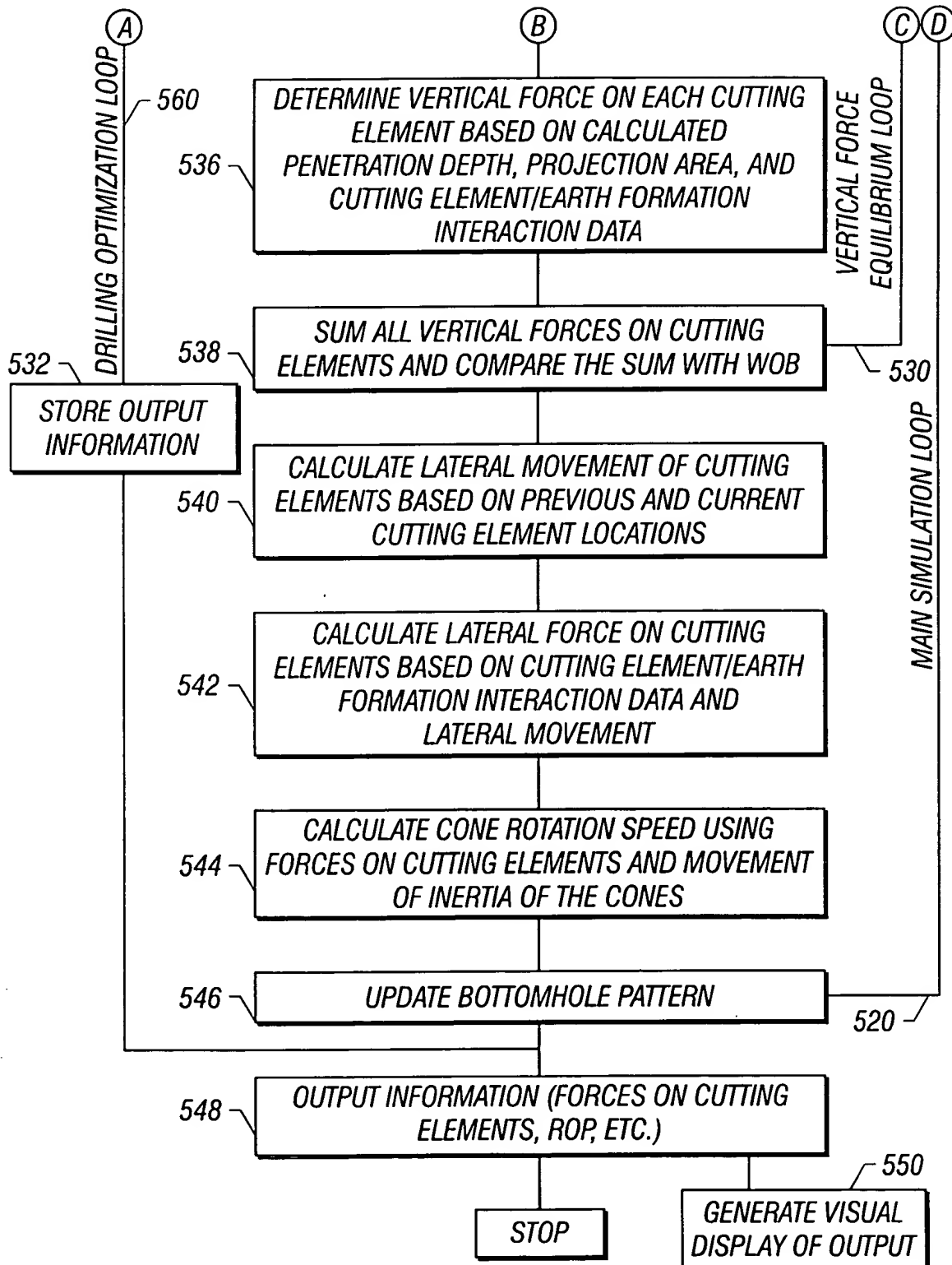


FIG. 11B